Long-Term Trends in Adolescent and Young Adult Smoking in the United States: Metapatterns and Implications

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Objectives. We sought to describe long-term adolescent and young adult smoking trends and patterns.

Methods. We analyzed adolescent data from Monitoring the Future, 1976 to 2005, and young adult (aged 18–24 years) data from the National Health Interview Survey, 1974 to 2005, overall and in subpopulations to identify trends in current cigarette smoking prevalence.

Results. Five metapatterns emerged: we found (1) a large increase and subsequent decrease in overall smoking over the past 15 years, (2) a steep decline in smoking among Blacks through the early 1990s, (3) a gender gap reversal among older adolescents and young adults who smoked over the past 15 years, (4) similar trends in smoking for most subgroups since the early 1990s, and (5) a large decline in smoking among young adults with less than a high school education.

Conclusions. Long-term patterns for adolescent and young adult cigarette smoking were decidedly nonlinear, and we found evidence of a cohort effect among young adults. Continued strong efforts and a long-term societal commitment to tobacco use prevention are needed, given the unprecedented declines in smoking among most subpopulations since the mid- to late 1990s. (*Am J Public Health.* 2008;98:905–915. doi:10.2105/AJPH.2007.115931)

Cigarette smoking has long been recognized as having high mortality, morbidity, and economic costs.[1–6] Because of the addictive nature of nicotine,[3,7] preventing cigarette smoking is an especially important societal goal.[4,8] Most regular smokers smoke their first cigarette by age 18 years,[9–11] although there is some evidence that the age of initiation may be increasing.[9,11] Because smoking initiation rarely occurs at later ages, the critical time for prevention occurs in adolescence and early adulthood.[4,9–13]

After a sharp increase in adolescent and young adult smoking that began during the late 1980s, there was a rapid and unprecedented decline in prevalence, especially among adolescents, beginning in the mid- to late 1990s.[9,14,15] Most surveys suggest that adolescent prevalence has slowed or leveled off over the past few years.[11,14,15]

Examining long-term trend data among adolescents and young adults can serve several purposes. Long-term trend data can help assess the effectiveness of past and existing prevention activities, assess the need for future prevention efforts, and predict the future burden of tobacco-related health effects.[16] Building on previous national trend studies,[3,12–26] we used smoothing techniques and regression analyses to comprehensively describe overall and subgroup-specific long-term cigarette smoking trends and to identify metapatterns among adolescents and young adults in the United States.

METHODS

Adolescent Data

We used data from the Monitoring the Future (MTF) study, which has conducted annual surveys since 1975. More-extensive details about MTF are provided elsewhere.[14] We considered using data from other national surveys, such as federal tobacco-specific youth surveys conducted before 1976,[12] the National Survey on Drug Use and Health (previously the National Household Survey on Drug Abuse),[27] the Youth Risk Behavior Survey,[15] and the National Youth Tobacco Survey.[28] We chose to use MTF because of its consistency in survey design and methodology, question wording, length of time over which the survey has been administered, sample size, and annual frequency of administration.

For MTF, nationally representative samples of students in public and private schools completed anonymous, self-administered surveys in classrooms each spring. Annual sample sizes averaged 16 000 students for each grade, and 130 to 140 schools for each grade participated annually.[14] School response rates ranged from 60% to 70% through 1990 and from 50% to 60% from 1991 through 2005; student response rates averaged 77% to 86% across all years.[14] For this study, MTF data were available from 1976 to 2005 for 12th-grade students and from 1991 to 2005 for 8th- and 10th-grade students.

Current smoking was defined as having smoked at least 1 cigarette within the past 30 days. We conducted separate overall analyses and stratified analyses by student demographics, along with parental education and college plans (as measures of family socioeconomic status and academic achievement).[4,12,17] We also analyzed data using a composite risk index measure developed by An et al. from 4 lifestyle factors (grade point average, truancy, number of nights out per week for fun or recreation, and level of religious commitment).[17] Respondents living in California were not asked about religious commitment beginning in 1997, so risk index data from 1997 to 2005 excluded California's respondents.

Young Adult Data

We obtained data on adults aged 18 to 24 years from the National Health Interview Survey for the years in which questions on smoking were included from 1974 to 2005; 1974 was chosen as the starting point because proxy responses about smoking were allowed previously. Data were collected through in-person household interviews; detailed descriptions of survey methods are provided

elsewhere.[29] Response rates averaged 73% to 90% during the study period; young adult sample sizes ranged from 1839 to 5663. We considered using other national surveys, particularly federal tobacco-specific adult surveys,[18] the National Survey on Drug Use and Health (previously the National Household Survey on Drug Abuse),[27] the Current Population Survey,[30] and the National Health and Nutrition Examination Survey.[31] We selected the National Health Interview Survey because of its general consistency in design and methods, length of time during which surveys were administered, sample size, and frequency of administration.

From 1974 to 1991, current smoking was defined as having smoked at least 100 cigarettes in a lifetime and smoking "now." From 1992 to 2005,[29,32] smoking was defined as having smoked 100 cigarettes in a lifetime and smoking "every day or some days." Analyses of 1992 data, when both questions were used, found that the new definition increased prevalence estimates by 2 percentage points for young adults; we adjusted 1974 to 1991 data by adding 2 percentage points to each estimate. As with adolescents, we analyzed overall and demographic-specific trends.[3,9,13,18–21]

Statistical Analyses

We used SAS version 9.0 (SAS Institute Inc, Cary, NC) and SUDAAN version 9.0 (Research Triangle Institute, Research Triangle Park, NC) for all analyses. Data were weighted to create nationally representative estimates. We used survey weights available on the public-use data sets. For MTF, standard errors were estimated by multiplying the square root of the survey design effect by the standard error expected under a binomial sampling scheme.[14] We used design effects available either through the MTF Web site[14] or from researchers at the University of Michigan. The Taylor series approximation in SUDAAN was used to compute standard errors for National Health Interview Survey data.

We examined overall and subgroup-specific trends for each grade. Subgroups included gender, race/ethnicity (limited to White, Black, and Hispanic because of sample-size constraints), geographic region, population density, parental education level, college plans, and risk index (high, moderate, or low risk). Additional analyses included gender by race/ethnicity, population density, and risk index. Gender by race/ethnicity data were based on pooled 2-year averages to provide more-stable estimates because of small annual sample sizes for some population groups.

Subgroup analyses among young adults included age (18–19 vs 20–24 years), gender, race/ethnicity, education level, geographic region, and population density. Additional analyses included gender by race/ethnicity, gender by education, and race/ethnicity by education.

We examined trends over time for each subgroup with scatter and smoothed-line plots. Line smoothing was done within SAS. A line was fit for the annual means for each population group with a cubic spline routine; spline fitting was used to help reveal underlying trends. We did not attempt to infer statistical differences among subgroups but instead used smoothed lines for exploratory analyses.

There was no a priori theoretical basis for hypothesizing a specific shape to the total population or subgroups over the periods covered, but we initially examined whether trends followed a polynomial model (e.g., quadratic, cubic) or other types of parametric curves. None of these approaches adequately fit these data when compared with visual inspection of the plotted means and smoothed-line trends, so we used piecewise linear regression modeling to statistically test changes in prevalence during different periods. Data analysts used a consensus approach to determine cut points to identify linear time trends by visual inspection of each line. The number of periods identified ranged from 2 to 5.

We used weighted least squares regression to fit regression lines to incorporate the different variances and design effects associated with estimated annual means.[33] We calculated significance for each linear slope coefficient; only $P<.01$ was considered significant because of the large number of slope coefficients tested. We selected figures that visually highlighted major findings and placed detailed results from regression analyses in the tables (all subgroup plots and smoothed lines are available as a supplement to the online version of the article at http://www.ajph.org).

RESULTS

The data for the total population showed a roller coaster trend pattern: smoking generally declined during the second half of the 1970s and early 1980s, leveled off by the mid- to late 1980s, increased through the mid- to late 1990s, and then declined through 2005 (Figure 1a, Tables 1 and 2). Adolescent trends in all grades from 1991 to 2005 were generally similar, with the exception of 8th-grade students, for whom smoking prevalence leveled off from 2002 to 2005 (Figure 1a, Table 1). In general, there was a time lag between changes in prevalence among adolescents, with changes occurring later among young adults. Changes in smoking among young adults since the mid-1990s were smaller than those seen for adolescents.

Adolescent Subgroups

Gender-specific patterns among 12th-grade students differed during the 1970s through the early 1990s (Figure 1b, Table 1). Prevalence declined steadily among adolescent girls during this period; by contrast, smoking declined rapidly among adolescent boys through the early 1980s before leveling. By 1990, prevalence was higher among adolescent boys than among girls, and this pattern persisted through 2005. Since 1991, trends in smoking by gender among students in grades 8 and 10 generally paralleled overall patterns (Figure 1b, Table 1), although there were no differences in prevalence between adolescent boys and girls. Unlike 8th-grade boys, 8th-grade girls (Table 1) had no significant change in smoking prevalence from 2002 to 2005; this was the primary cause of the overall lack of decline among 8th-grade students.

Smoking among 12th-grade students differed by racial/ethnic groups (Figure 1c, Table 1). Estimates for racial/ethnic groups were similar in the late 1970s; by the mid-1980s, a substantial gap developed—Hispanics and, especially, Blacks were less likely than were Whites to smoke. By the early 1990s, smoking was 2 to 4 times as common among Hispanics and Whites as among Blacks. Since 1991, however, racial/ethnic trends among adolescents have been more similar (Figure 1c, Table 1).

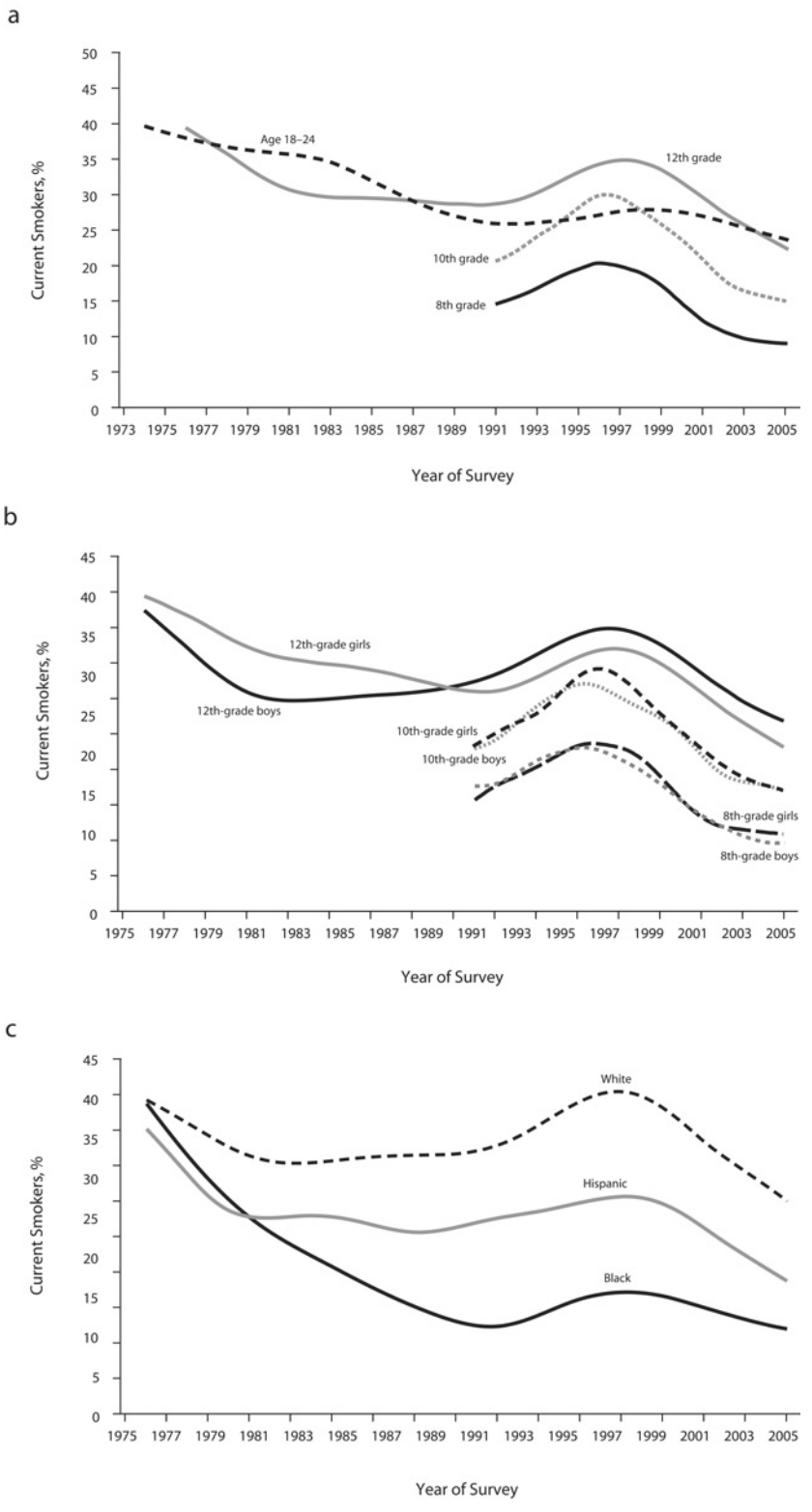

FIGURE 1—Trends in cigarette smoking among US adolescents and young adults overall (a), among 12th-, 10th-, and 8th- grade boys and girls (b), and among 12th-grade students, by race/ethnicity (c): Monitoring the Future, 1976–2005.

Regional and population-density trends generally mirrored overall trends, although estimates were generally lowest in western states and among residents in metropolitan statistical areas in all years (figures not shown). However, among 8th-grade students, there were no declines between 2002 and 2005 in the Northeast and South or among residents outside metropolitan statistical areas (Table 1). Trends by parental education, college plans, and risk index scores also paralleled overall trends (figures not shown).

Young Adult Subgroups

Young adult trends by age group, region, and population density were generally similar to overall trends, but there were gender differences (Figure 2a, Table 2). Smoking prevalence among young women was level from the mid-1970s through the mid-1980s but declined over this period for young men. From 1985 to 1991, prevalence declined at a faster rate among young women than among men. The increase in young adult smoking during the 1990s occurred predominantly among young adult men, opening up a persistent gap between genders of approximately 5%. Declines since 2001 were similar for young men and women.

Trends among young adults differed by race/ethnicity (Figure 2b, Table 2). For Whites, smoking prevalence was level from the late 1970s through the early 1980s, declined until 1990, then slowly increased through the late 1990s before declining through 2005. For Hispanics, smoking declined rapidly from the late 1970s through the 1980s, leveled off through the late 1990s, and then declined slowly. For Blacks, smoking declined precipitously (a relative decrease of more than two thirds) from the early 1980s through the mid-1990s but then increased until the early 2000s before declining slightly.

Trends also differed by education level (Figure 2c, Table 2), with smoking among more highly educated young adults declining steadily until the early 1990s. Smoking declined among high school graduates and those with less than a high school degree during much of the 1980s and early 1990s. Increases during the 1990s occurred only among persons with at least a high school

TABLE 1—Overall and Subgroup-Specific Trends in Cigarette Smoking Among US Adolescents: Monitoring the Future, 1976–2005

Population	Time 1 (Slope)	Time 2 (Slope)	Time 3 (Slope)	Time 4 (Slope)	Time 5 (Slope)	R^2
			Grade 12, 1976–2005			
Overall	1976–1981 (–1.9)*	1981–1992 (–0.2)*	…	1992–1997 (1.7)*	1997–2005 (–1.8)*	0.96
Gender						
Boy	1976–1980 (–3.0)*	1980–1990 (0.1)	…	1990–1997 (1.3)*	1997–2005 (–1.7)*	0.94
Girl	1976–1992 (–0.7)*	…	…	1992–1997 (1.8)*	1997–2005 (–1.8)*	0.92
Race/ethnicity						
White	1976–1981 (–1.7)*	1981–1992 (0.1)	…	1992–1997 (1.9)*	1997–2005 (–2.0)*	0.95
Black	1976–1992 (–1.6)*	…	…	1992–1997 (1.7)*	1997–2005 (–0.8)*	0.93
Hispanic	1976–1980 (–3.3)*	1980–1985 (0.3)	1985–1989 (–0.8)	1989–1999 (0.6)*	1999–2005 (–2.0)*	0.93
Region						
Northeast	1976–1981 (–2.4)*	1981–1986 (0.4)	1986–1992 (–0.8)*	1992–1997 (2.0)*	1997–2005 (–2.2)*	0.84
Midwest	1976–1980 (–2.5)*	1980–1992 (0.0)		1992–1998 (1.2)*	1998–2005 (–2.1)*	0.88
South	1976–1985 (–1.4)*	1985–1991 (0.1)	1991–1999 (1.2)*	1999–2002 (–3.8)*	2002–2005 (1.0)	0.89
West	1976–1982 (–1.6)*	1982–1985 (2.0)*	1985–1992 (–0.5)	1992–1997 (1.5)*	1997–2005 (–1.5)*	0.79
Population density						
MSA	1976–1981 (–1.8)*	1981–1992 (–0.2)	…	1992–1997 (1.5)*	1997–2005 (–1.7)*	0.94
Non-MSA	1976–1980 (–2.7)*	1980–1993 (–0.1)	…	1993–1997 (2.8)*	1997–2005 (–1.9)*	0.92
Parental Education						
Low	1976–1989 (–1.2)*	1989–1998 (0.8)*	…		1998–2005 (–1.9)*	0.90
Intermediate	1976–1981 (–2.0)*	1981–1993 (–0.1)	…	1993–1998 (1.4)*	1998–2005 (–1.8)*	0.92
High	1976–1980 (–2.4)*	1980–1991 (0.0)	…	1991–1997 (1.5)*	1997–2005 (–2.0)*	0.91
College plans						
None or < 4 y	1976–1981 (–1.8)*	1981–1993 (0.0)	…	1993–1998 (1.8)*	1998–2005 (–2.0)*	0.91
4 y	1976–1980 (–2.2)*	1980–1992 (0.2)*	…	1992–1997 (1.7)*	1997–2005 (–1.8)*	0.94
Risk index						
High	1976–1981 (–2.4)*	1981–1991 (–0.2)	…	1991–1997 (2.0)*	1997–2005 (–1.7)*	0.88
Moderate	1976–1992 (–0.6)*	…	…	1992–1997 (2.7)*	1997–2005 (–1.9)*	0.78
Low	1976–1992 (–0.4)*	…	…	1992–1997 (1.7)*	1997–2005 (–1.5)*	0.87
Gender by race/ethnicity[a]						
White boys	1977–1980 (–3.4)*	1980–1990 (0.2)	…	1990–1997 (1.7)*	1997–2005 (–1.7)*	0.92
Black boys	1977–1980 (–4.2)*	1980–1990 (–1.3)*	…	1990–1997 (1.1)*	1997–2005 (–0.6)	0.85
Hispanic boys	1977–1980 (–4.8)*	1980–1990 (0.4)	…	1990–1997 (0.6)*	1997–2005 (–1.2)*	0.64
White girls	1977–1992 (–0.5)*	…	…	1992–1997 (2.0)*	1997–2005 (–1.8)*	0.81
Black girls	1977–1992 (–1.8)*	…	…	1992–1997 (1.0)*	1997–2005 (–0.5)*	0.98
Hispanic girls	1977–1992 (–0.9)*	…	…	1992–1997 (1.7)*	1997–2005 (–1.4)*	0.70
Gender by population density						
MSA boys	1976–1980 (–2.8)*	1980–1990 (0.1)	…	1990–1997 (1.3)*	1997–2005 (–1.7)*	0.94
Non-MSA boys	1976–1980 (–3.5)*	1980–1990 (0.0)	…	1990–1997 (1.4)*	1997–2005 (–1.6)*	0.79
MSA girls	1976–1992 (–0.8)*	…	…	1992–1997 (1.5)*	1997–2005 (–1.8)*	0.91
Non-MSA girls	1976–1992 (–0.6)*	…	…	1992–1997 (2.7)*	1997–2005 (–2.0)*	0.78
Gender by risk index						
High-risk boys	1976–1981 (–2.7)*	1981–1991 (0.2)	…	1991–1997 (2.1)*	1997–2005 (–1.5)*	0.88
Moderate-risk boys	1976–1992 (–0.6)*	…	…	1992–1997 (2.8)*	1997–2005 (–1.8)*	0.59
Low-risk boys	1976–1992 (–1.7)	…	…	1992–1997 (2.0)*	1997–2005 (–1.6)*	0.70
High-risk girls	1976–1981 (–2.0)*	1981–1991 (–0.9)	…	1991–1997 (2.0)*	1997–2005 (–1.9)*	0.87
Moderate-risk girls	1976–1992 (–0.9)*	…	…	1992–1997 (2.5)*	1997–2005 (–2.0)*	0.86
Low-risk girls	1976–1992 (–0.6)*	…	…	1992–1997 (1.5)*	1997–2005 (–1.4)*	0.90

Continued

TABLE 1—*Continued*

			Grade 8, 1991–2005			
Overall	…	…	1991–1996 (1.4)*	1996–2002 (–1.7)*	2002–2005 (–0.6)	0.98
Gender						
Boy	…	…	1991–1996 (1.1)*	…	1996–2005 (–1.5)*	0.96
Girl	…	…	1991–1996 (1.6)*	1996–2002 (–1.8)*	2002–2005 (–0.4)	0.95
Race/ethnicity						
White	…	…	1991–1996 (1.8)*	1996–2002 (–2.1)*	2002–2005 (–0.8)*	0.98
Black	…	…	1991–1996 (1.2)*	1996–1999 (–0.4)	2002–2005 (–0.6)*	0.78
Hispanic	…	…	1991–1994 (2.1)	1994–1999 (–0.9)	1999–2005 (–1.6)*	0.90
Region						
Northeast	…	…	1991–1996 (1.5)*	1996–2002 (–1.9)*	2002–2005 (–0.8)	0.96
Midwest	…	…	1991–1996 (1.6)*	…	1996–2005 (–1.6)*	0.84
South	…	…	1991–1998 (0.7)*	1998–2002 (–2.4)*	2002–2005 (–0.3)	0.94
West	…	…	1991–1994 (2.7)*	…	1994–2005 (–1.2)*	0.92
Population density						
MSA	…	…	1991–1996 (1.3)*	1996–2002 (–1.9)*	1996–2005 (–1.6)*	0.95
Non-MSA	…	…	1991–1999 (1.3)*	1996–2002 (–3.8)*	2002–2005 (–0.9)	0.96
Parental education						
Low	…	…	1991–1993 (–1.4)	1993–1997 (1.2)*	1997–2005 (–1.7)*	0.92
Intermediate	…	…	1991–1996 (1.6)*	…	1996–2005 (–1.4)*	0.92
High	…	…	1991–1996 (1.2)*	…	1996–2005 (–1.4)*	0.93
College plans						
None or < 4 y	…	…	1991–1999 (1.0)*	…	1999–2005 (–2.8)*	0.79
4 y	…	…	1991–1996 (1.2)*	…	1996–2005 (–1.3)*	0.95
Risk index						
High	…	…	1991–1996 (3.1)*	…	1996–2005 (–2.4)*	0.88
Moderate	…	…	1991–1996 (1.9)*	…	1996–2005 (–1.8)*	0.94
Low	…		1991–1997 (0.6)*	…	1997–2005 (–1.0)*	0.91
Gender by race/ethnicity[a]						
White boys	…	…	1992–1996 (1.8)*	…	1996–2005 (–1.7)*	0.97
Black boys	…	…	1992–1996 (1.9)*	…	1996–2005 (–0.6)*	0.90
Hispanic boys	…	…	1992–1996 (0.8)	…	1996–2005 (–1.4)*	0.87
White girls	…	…	1992–1996 (2.3)*	1996–2002 (–1.9)*	2002–2005 (–1.1)	0.94
Black girls	…	…	1992–1996 (1.0)*	1996–2002 (–0.4)	2002–2005 (–0.5)	0.59
Hispanic girls	…	…	1992–1996 (1.4)*	1996–2002 (–1.6)*	2002–2005 (–1.0)	0.89
Gender by population density						
MSA boys	…	…	1991–1996 (0.8)*	…	1996–2005 (–1.4)*	0.96
Non-MSA boys	…	…	1991–1996 (1.7)*	…	1996–2005 (–1.5)*	0.77
MSA girls	…	…	1991–1996 (1.2)*	1996–2002 (–2.0)*	2002–2005 (0.1)	0.98
Non-MSA girls	…	…	1991–1996 (2.2)*	1996–2002 (–1.0)*	2002–2005 (–2.2)	0.66
Gender by risk index						
High-risk boys	…	…	1991–1996 (2.7)*	…	1996–2005 (–2.4)*	0.87
Moderate-risk boys	…	…	1991–1996 (1.4)*	…	1996–2005 (–1.5)*	0.90
Low-risk boys	…	…	1991–1997 (0.5)*	…	1997–2005 (–1.0)*	0.91
High-risk girls	…	…	1991–1996 (3.6)*	…	1996–2005 (–2.4)*	0.83
Moderate-risk girls	…	…	1991–1996 (2.3)*	…	1996–2005 (–2.0)*	0.93
Low-risk girls	…	…	1991–1997 (0.8)*	…	1997–2005 (–1.0)*	0.86

Note. MSA = metropolitan statistical area. Ellipses indicate data not available. Overall and subgroup-specific data on 10th-grade students are available as a supplement to the online version of this article at http://www.ajph.org.

[a]Gender by race/ethnicity data were based on pooled 2-year averages to provide more stable estimates.

*$P < .01$.

TABLE 2—Overall and Subgroup-Specific Trends in Cigarette Smoking Among Adults Aged 18–24 Years: National Health Interview Survey, 1974–2005

	Time 1 (Slope)	Time 2 (Slope)	Time 3 (Slope)	Time 4 (Slope)	R^2
Overall	1974–1991 (–0.9*)	. . .	1991–1997 (0.5)	1997–2005 (–0.5)*	0.91
Age, y					
18–19	1974–1990 (–1.0)*	. . .	1990–1998 (0.4)	1998–2005 (–0.8)*	0.87
20–24	1974–1983 (–0.2)	1983–1991 (–1.5)*	1991–1997 (0.7)*	1997–2005 (–0.5)*	0.94
Gender					
Men	1974–1991 (–1.0)*	. . .	1991–1997 (1.0)*	1997–2005 (–0.6)*	0.89
Women	1974–1985 (–0.2)	1985–1991 (–1.8)*	1991–1999 (0.3)	1999–2005 (–0.8)*	0.92
Race/ethnicity					
White	1978–1983 (0.0)	1983–1991 (–1.0)*	1991–1997 (0.9)*	1997–2005 (–0.7)*	0.81
Black	1978–1980 (1.1)	1980–1995 (–1.9)*	1995–1999 (2.2)*	1999–2005 (–0.3)	0.91
Hispanic	1978–1992 (–1.0)*	. . .	. . .	1992–2005 (–0.1)	0.75
Education					
Less than high school	1974–1980 (0.6)	1980–1994 (–1.5)*	1994–1998 (0.2)	1998–2005 (–0.8)*	0.96
High school	1974–1983 (–0.2)	1983–1991 (–1.3)*	1991–1999 (0.8)*	1999–2005 (–0.8)	0.81
More than high school	1974–1991 (–0.8)*	. . .	1991–1998 (1.1)*	1998–2005 (–0.7)	0.86
Region					
Northeast	1974–1991 (–1.0)*	. . .	1991–1998 (0.5)	1998–2005 (–1.1)*	0.83
Midwest	1974–1991 (–0.8)*	. . .	1991–1997 (0.9)*	1997–2005 (–0.6)	0.83
South	1974–1991 (–1.0)*	. . .	1991–1997 (0.5)	1997–2005 (–0.2)	0.86
West	1974–1990 (–0.8)*	. . .	1990–1997 (–0.3)	1997–2005 (–0.4)	0.86
Population density					
MSA	1974–1991 (–1.0)*	. . .	1991–1995 (0.3)	1995–2005 (0.1)	0.96
Non-MSA	1974–1983 (0.3)	1983–1991 (–1.4)*	1991–1997 (0.9)	1997–2005 (–0.7)	0.80
Gender by race/ethnicity					
White men	1978–1991 (–0.7)*	. . .	1991–1997 (1.1)*	1997–2005 (–0.5)	0.72
White women	1978–1985 (–0.0)	1985–1991 (–1.3)*	1991–1999 (0.4)	1999–2005 (–1.1)	0.74
Black men	1978–1991 (–2.0)*	. . .	1991–1997 (0.7)	1997–2005 (–0.2)	0.87
Black women	1978–1985 (–0.6)	1985–1991 (–3.1)*	1991–1999 (0.0)	1999–2005 (0.7)	0.83
Hispanic men	1978–1991 (–1.1)*	. . .	1991–1997 (0.5)	1997–2005 (–0.2)	0.30
Hispanic women	1978–1985 (–1.6)*	1985–1991 (–1.1)	1991–1999 (–0.2)	1999–2005 (–0.4)	0.80
Gender by education					
Men, less than high school	1974–1991 (–1.2)*	. . .	1991–1997 (–0.5)	1997–2005 (–0.7)	0.90
Men, high school	1974–1991 (–0.8)*	. . .	1991–1997 (1.2)*	1997–2005 (–0.3)	0.71
Men, more than high school	1974–1991 (–0.9)*	. . .	1991–1997 (2.0)*	1997–2005 (–0.7)	0.68
Women, less than high school	1974–1985 (0.3)	1985–1991 (–2.9)*	1991–1999 (–0.7)	1999–2005 (–0.5)	0.89
Women, high school	1974–1985 (0.1)	1985–1991 (–1.9)*	1991–1999 (0.7)	1999–2005 (–1.1)	0.80
Women, more than high school	1974–1985 (–0.6)*	1985–1991 (–0.7)*	1991–1999 (0.6)*	1999–2005 (–0.7)	0.73
Race/ethnicity by education					
White, less than high school	1978–1983 (0.0)	1983–1991 (–1.0)*	1991–1997 (–0.8)	1997–2005 (–0.5)	0.91
White, high school	1978–1983 (0.3)	1983–1991 (–1.0)*	1991–1997 (1.4)*	1997–2005 (–0.5)	0.53
White, more than high school	1978–1983 (–0.7)	1983–1991 (–0.4)	1991–1997 (1.4)*	1997–2005 (–0.6)*	0.83
Black, less than high school	1978–1980 (5.8)	1980–1995 (–2.6)*	1995–1999 (3.1)*	1999–2005 (–0.6)	0.90
Black, high school	1978–1980 (4.1)	1980–1995 (–1.8)*	1995–1999 (2.3)	1999–2005 (–0.1)	0.74
Black, more than high school	1978–1980 (–2.4)	1980–1995 (–1.3)*	1995–1999 (1.4)	1999–2005 (0.3)	0.79
Hispanic, less than high school	1978–1992 (–1.3)*	. . .	. . .	1992–2005 (–0.4)	0.65
Hispanic, high school	1978–1992 (–1.2)*	. . .	. . .	1992–2005 (0.2)	0.52
Hispanic, more than high school	1978–1992 (–0.6)	. . .	. . .	1992–2005 (0.0)	0.12

Note. MSA = metropolitan statistical area. Ellipses indicate data not available.
*$P < .01$.

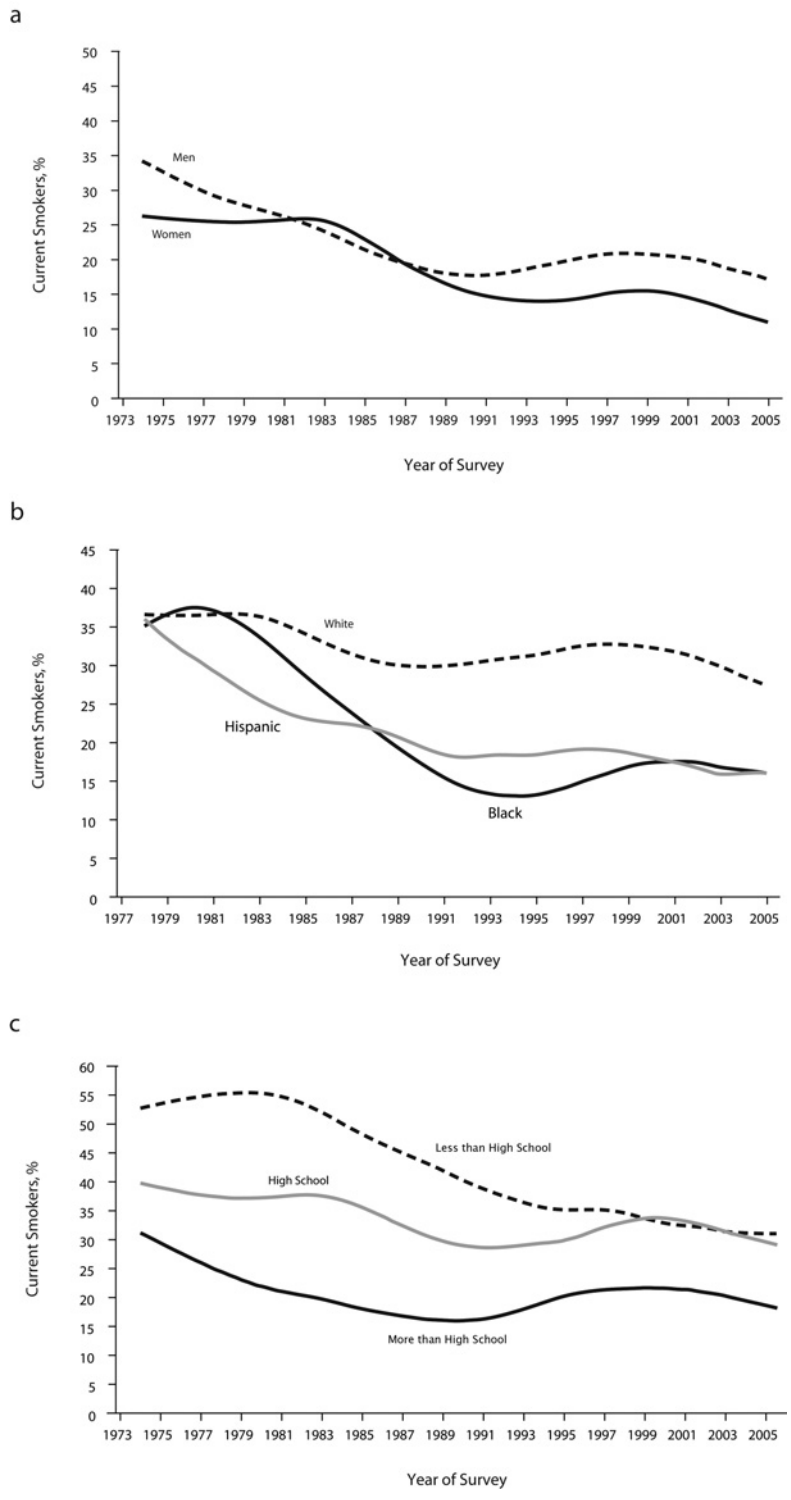

FIGURE 2—Trends in cigarette smoking among US adults aged 18 to 24 years, by gender (a), race/ethnicity (b), and education level (c): National Health Interview Survey, 1974–2005.

degree, remaining level or declining among those without a high school degree. The 12% to 20% gap during 1974 to 1985 between young adults with and without a high school degree disappeared by the late 1990s (Figure 2c). From 2001 to 2005, smoking declined across all education levels. However, a large gap persisted between young adults with at least some college and those with lower education levels.

DISCUSSION

Unlike cigarette smoking trends for all adults, which generally declined linearly over the past 30 years,[13,22,25] long-term smoking trends for adolescents and young adults were decidedly nonlinear. After a steep decline and then a leveling off from the mid-1970s through the early 1990s, smoking prevalence sharply increased through much of the 1990s, then abruptly reversed. Since about 1990, overall young adult trends were similar to adolescent trends but lagged by a couple of years. This pattern suggests a cohort effect, with previous adolescent smoking behavior affecting young adult behavior. Our overall findings on recent trends in adolescent prevalence, particularly the recent lack of decline among 8th-grade students, are consistent with those reported by some,[11,14,34] but not all, other national surveys.[15,28]

Given the nature of collecting data with serial cross-sectional surveys of independent nationally representative samples, and the array of complex and interrelated determinants of tobacco use (i.e., at the individual, immediate social context, and broader societal or environmental level),[12,35,36] it is not possible to specify conclusive cause-and-effect relationships to explain the observed trends. Instead, we identified 5 long-term metapatterns and the major factors that may have influenced them. These patterns are noteworthy because of their potential implications for tobacco prevention and control and because they may lead to hypotheses warranting further research.

Rapid Increase and Decline in Smoking Over the Past 15 Years

Smoking prevalence sharply increased through much of the 1990s, followed by a

steep decline; this decline resulted in smoking estimates reaching unprecedented low levels by the beginning of the 21st century. We speculate that tobacco company efforts may have contributed to the rapid increase in smoking prevalence and that broad-based tobacco prevention strategies widely used since the early to mid-1990s contributed to the subsequent rapid decrease in smoking.[4,12] Generational factors may also have contributed to the overall observed increase and decrease in smoking.

By the early to mid-1980s, tobacco companies made a major commitment to market directly to adolescents; their approaches included placement of tobacco products in movies, developing nontobacco product lines with company symbols (e.g., hats and T-shirts), and sponsorship of youth-focused events such as rock music concerts.[37–41] This marketing was perhaps most obvious in the Smooth Character cartoon-oriented campaign for Camel cigarettes.[42] The industry also developed products that were more acceptable to younger audiences.[37,42] For example, Camel cigarettes were redesigned beginning in the 1980s to increase acceptability by reducing throat irritation and maintaining or increasing nicotine levels.[42] More recently, flavored cigarettes have been introduced that appeal more strongly to younger audiences.[37,43,44] Price has a strong influence on smoking among young people, and tobacco industry discounting may also have been a contributing factor to the rapid increase in prevalence.[4,45,46]

Generational forgetting may also have contributed to the increase in smoking beginning in the early 1990s.[47–49] This concept has been proposed to explain long-term cyclical trends in illegal drug use: the increased societal visibility of the adverse effects of addiction led to reductions in young people initiating drug use. Over time, however, as the number and visibility of users declined and other issues received greater attention, subsequent birth cohorts may have had lower levels of perceived risk (forgetting) and become more likely to initiate dangerous behaviors. The same phenomenon might occur with smoking.

The major strategies for preventing tobacco use are educational efforts, regulatory efforts, economic approaches, and comprehensive programs.[4,50] These interventions probably contributed to the rapid decrease in cigarette smoking among adolescents and young adults that began in the mid- to late 1990s.[4,5,24,45,50–53] Since the early 1990s, broader, population-based (upstream) approaches, such as secondhand tobacco smoke ordinances, excise tax increases, and comprehensive population-based programs, have been widely implemented. Research has clearly shown that these approaches have been effective in reducing smoking among adolescents and young adults.[4,5,24,45,50–53]

Declines have been observed among adolescents and young adults born after 1982 (the so-called millennial generation) in risky sexual behavior, adolescent pregnancy rates, and some (although not all) forms of other drug use since the early to mid-1990s.[11,14,15,54,55] This generation is more optimistic and accepting of authority and less likely than previous generations to rebel against their parents through high-risk behaviors.[56]

Trends by Race/Ethnicity, Gender, and Birth Cohort

The most striking racial/ethnic difference in trends over the past 30 years was the steep decline among Blacks from the mid-1970s through the early 1990s.[12,17,57] This population rapidly went from the highest to lowest smoking prevalence among the racial/ethnic groups examined.

No widely accepted explanation exists for this steep decline among Black adolescents and young adults. The presence and interrelationships of individual, social, societal, and cultural factors in Black and other subgroups are complex.[57] There is evidence that there are stronger parental nonsmoking norms, a greater perception that smoking represents disrespect for parents, and a stronger belief that smoking would be detrimental to future opportunities (e.g., employment) among Blacks, especially among females.[36,58–60] Further research is needed to identify and understand factors influencing the initiation and prevention of smoking in racial/ethnic groups.[57]

Smoking prevalence among 12th-grade girls and young adult women, which was similar to or slightly higher than it was among males in these age groups until about 1990, was reversed. This has resulted in a gender gap of a few percentage points, with higher prevalence among older adolescent boys and young men.

The determinants of smoking are somewhat different for males and females,[3,35,36,61,62] but there has been little research to explain recent trends in these gender differences.[3,7,36,63] Racial/ethnic differences may account for some of the difference, because the increase in smoking seen during most of the 1990s was greater among Black and Hispanic adolescent boys than girls. A growing academic achievement difference has developed between adolescent girls and boys in middle and high school, and the percentage of male undergraduate college students has declined.[64,65] Adolescents with higher achievement levels and young adults attending college are less likely to smoke.[11,13,17,35]

Gender differences in smoking may reflect broader changes leading to improvements for women in societal status and opportunity.[66] Although probably playing a lesser role, the steep decline in smoking among pregnant women[3,67] may reflect increased awareness of the adverse effects of smoking on fetal health and reinforce norms against smoking among women.

Although there were some differences in magnitude, increases and decreases in smoking since the early 1990s were remarkably similar across most subgroups. This homogenization strongly suggests that factors influencing decisions by adolescents and young adults about initiating cigarette smoking have been fairly universal across subgroups and recent birth cohorts.

Others have noted a growing tendency among young people in recent years to adopt generally similar beliefs, values, and behaviors, which may help explain smoking trends.[56] Other forms of behavior homogenization in populations have been noted in the United States and elsewhere and are attributed, in part, to the greater presence and use of communication media.[68,69]

Decline in Smoking Among Young Adults With Less Than a High School Education

An unexpected finding in our study was the decline in smoking among young adults with less than a high school education, especially in comparison with trends among persons with higher levels of education.[70] Although

estimates were substantially lower among young adults with higher levels of education, the declining prevalence trend among less educated young adults, to our knowledge, has not been reported elsewhere.

It is not clear whether young adults with less than a high school education are becoming less likely to initiate smoking or more likely to quit or there is some combination of the two. It is evident, however, that tobacco companies have stepped up their marketing efforts to young adults in college.[71–73] One contributing factor was the racial/ethnic difference in smoking trends through the mid-1990s. A greater decline in smoking occurred among Blacks and Hispanics than among Whites over this period, and a slightly higher percentage of Black and Hispanic than White young adults had less than a high school education.[74–77] However, racial/ethnic differences do not fully account for the differences in trends by education level for young adults. More research is needed to better understand the differing trends in smoking among young adults by level of education.

Limitations

Our study had several limitations. Trends among 8th- and 10th-grade students were derived from data from fewer years than were available for 12th-grade students and young adults. Self-reports tend to slightly underestimate the actual use of cigarettes,[78–82] although this should not affect trends.

There is concern that the validity of self-reports of smoking may decrease as smoking becomes less socially accepted in the United States.[12,81,82] However, a recent national study of adolescents found that smoking prevalence estimates derived from self-reports were only 1.3% lower than those derived from salivary cotinine levels, suggesting that self-reports for adolescents remain a valid measure for assessing smoking status.[83]

We adjusted previous-year estimates for the change in definition of current smoking for young adults, but it is possible that the difference between estimates derived from the new definition was different in earlier years. We conducted a large number of analyses, so although we used α at less than .01 to assess statistical significance, some statistically significant differences occurred by chance.

Implications of These Findings

Despite recent dramatic improvements, preventing tobacco use remains a continuing societal challenge. Given historical trends, there is no reason to assume that adolescent or young adult smoking will remain at the historically low levels achieved in recent years. Our findings that the decline in prevalence among 8th-grade students has slowed considerably or even ended for several subgroups since 2002, along with findings from the 2005 Youth Risk Behavior Survey[15] and 2006 MTF survey,[34] are especially troubling because they may portend a pattern that will persist into adulthood. The tobacco industry has shown a remarkable ability to adapt and adjust to tobacco-use prevention efforts, with strategies such as price discounting,[28] airing of ineffective youth antitobacco advertisements,[84] and promotions targeting young adults in bars and clubs.[71]

There is a real danger in thinking that the tobacco problem has been solved, because it may divert attention and limited public health resources elsewhere. Funding by the tobacco companies for the American Legacy Foundation as part of the 1998 Master Settlement Agreement has ended. The level of exposure of adolescents to state-funded tobacco counteradvertising on television has declined.[85] Many successful comprehensive state tobacco control programs have been cut: between fiscal years 2002 and 2004 alone, there was an overall decline of 28% in state spending on such programs, and funding levels only increased by 1% in fiscal years 2004 through 2006.[86] Given the great success in reducing smoking among adolescents and young adults in recent years and the strong evidence base for effective interventions, there is a continuing need to support broad tobacco-use prevention efforts. ■

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Contributors

D.E. Nelson originated the study, supervised all aspects of its implementation, and led the writing. P. Mowery contributed to the conception and design of the study, led the analyses of data, and contributed to the writing. K. Asman contributed to the analyses of data. L.L. Pederson contributed to the conception and design of the study and drafting the article. P.M. O'Malley contributed to data acquisition and analyses and critical revisions of the text. A. Malarcher contributed to the analysis and interpretation of data and critical revisions of the text. E.W. Maibach contributed to the interpretation of data and critical revisions of the text. T.F. Pechacek contributed to the conception and design of the study and critical revisions of the text.

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Human Participant Protection

This study was based on secondary analyses of Monitoring the Future and National Health Interview Survey data sets. Data collection for the Monitoring the Future study was approved by the institutional review board at the University of Michigan and for the National Health Interview Survey by the institutional review board at the Centers for Disease Control and Prevention.

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